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Building Information Management (BIM) Education in the Dominican Republic: An Empirical Study

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Abstract

Building Information Management (BIM) education is par excellence the best solution to overcome the lack of BIM knowledge and BIM skilled professionals that affect the implementation of BIM in the Architecture, Engineering, and Construction (AEC) industry. Moreover, BIM education is vital to drive the implementation and evolution of BIM in the AEC industry. However, its provision can be a difficult task, more for BIM infant countries such as the Dominican Republic (DR). By adopting a qualitative approach, using semi-structured interviews with nine professionals involved in BIM education, this study aims to explore the presence of BIM education in the DR. The data gathered was analysed with the method of content analysis. The findings mainly indicated: a shortage of BIM experts; lack of BIM education, as there is currently provided only BIM training based on software; and the dissemination of BIM knowledge through educational activities and BIM communities. However, the provision of BIM education is likely to expand. Most of the current training providers are eager to continue with their work and get into further areas, and there is also evidence of the first plan of inserting BIM in a university curriculum. These results infer that, for an infant country, BIM education seems to be heading in the right direction in the DR. The implementation of BIM is likely to increase, along with the provision and demand of BIM education in the country. This research may be beneficial to professional and policy makers interested in BIM education in BIM infant countries.

Keywords: BIM education, BIM infant country, BIM training

1. Introduction

The AEC industry has extensively explored methods to reduce project cost, enhance efficiency and quality and decrease project delivery team and is believed that Building Information Management (BIM) provides the potential to attain these purposes (Azhar 2011). BIM is defined as “the process of creating, storing, managing, exchanging and sharing building information in an interoperable way and reusable way.” It demands the creation and use of a computer-generated model to represent the planning, design, construction and operational stages of projects (Eadie *et al.* 2013). As one of the most significant technological advances in the building design and construction industry, BIM has been capturing the attention of the worldwide AEC industry (Liu *et al.* 2015). The increment of BIM Government initiatives has motivated the professionals of the AEC industry worldwide to opt for its implementation. This boost of BIM adoption has generated the need for BIM skilled professionals (Suwal *et al.* 2013). However, this requirement has been difficult to fulfil as the lack of BIM skilled professionals is a challenge to the universal adoption of BIM in the AEC industry (Gardner *et al.* 2014; Macdonald 2012; Suwal *et al.* 2013).

BIM education is considered as the solution to speed up the BIM learning curve hence companies can employ ready-made BIM professionals when students finish their studies (Wu and Issa 2013). There are several stakeholders involved in the delivery of BIM education: Academia, Industry, software companies, local chapters of diverse type of associations, vocational training institutions and BIM learners (AIA-CA 2012; CIC 2013; Rooney 2017). Academia is the primary provider of BIM education while the other stakeholders provide BIM training, which is a complementing part of the process of BIM education.

It is believed that the essential education needed to overcome the lack of BIM skilled personnel needs to come from higher education institutions (Miller *et al.* 2013). Currently, there is a growing number of universities worldwide that are either researching about BIM or have enthusiastically started the integration of BIM in the multidisciplinary curriculum at

undergraduate and graduate levels (AIA 2012). However, they have been criticized for their deficiency in introducing BIM into an existing or future curricula, and numerous academic programs have not been able to meet industry and student's expectations (Wu and Issa 2013). For a successful integration of BIM in academia, the alliance of academia and the industry has been suggested as well as the creation of frameworks to direct and assist this process (AIA 2012; Byrne 2015; Macdonald & Granroth 2013; Macdonald 2012; Macdonald & Mills 2011).

The present study explores the status of BIM education in the DR, and it is part of the ongoing research study entitled "Decision support toolkit to implement BIM in the DR."

2. Contextualisation of the Dominican Republic

The AEC industry is one of the sectors that more contributes to the economy's growth of the DR (Soler *et al.* 2013). According to Banco Central de la República Dominicana (2015), the sector registered an annual growth of 13.8% in 2014 driven by both private and public investment. As per Soler *et al.* (2013), despite showing a sustainable and continuous growth, the Dominican AEC industry is lacking, in many cases, of a qualified workforce and innovative and efficient construction techniques. Recommendations for the enhancement of the sector include the necessity of implementing technologies to improve the communication among construction parties; have better control of the different disciplines involved in a construction project; reduce the response time and get precise and reliable data, and facilitate and make construction processes more efficient and sustainable. In the presence of these needs, this research suggests the adoption of BIM as the solution to improve the Dominican AEC industry.

Currently, the status of BIM implementation in the DR is unknown. There is a paucity of research about the implementation of BIM in the DR construction industry. Therefore, this research aims to bridge this research gap.

3. Research methodology

The research process undertaken comprehended a literature review which pointed out the scarcity of information about the AEC industry and the implementation of BIM in the country. A qualitative approach was adopted to explore these unknown aspects of the country (Creswell and Poth 2017). It was considered to collect this data through the experience and perspective of professionals of the Dominican construction industry. As per Alshenqeeti (2014), interviews are methods where people can share their insight and interpretation of a given topic. Therefore, they were the selected as the research strategy for collecting data. The interviews were especially semi-structured. The data has been collected in two phases namely: the preliminary study and the main study.

3.1 Preliminary study

The preliminary study was conducted to explore the Dominican AEC industry and inquire about the BIM implementation in the country before undertaking the main study. Data was collected in January 2016 by interviewing 17 professionals from 12 construction organisations. The study presented patterns of the way of work in the Dominican AEC industry. Concerning BIM, it gave an outlook on aspects such as the levels of BIM awareness and BIM implementation; interest in BIM; and challenges to implementing BIM in the country. In general, the findings categorised the DR as a BIM infant country which is defined by Rogers *et al.* (2015) as a country whose AEC industry does not develop any project that is BIM; however, it is interested in implementing BIM in future.

Furthermore, BIM education was an important theme that arose in the preliminary study. First, it was brought up through the lack of BIM skilled personnel, which was identified as a significant challenge to implementing BIM in the country. Regarding importance, the barrier was ranked as high by 27% of the participants, as medium by 45%, and as low by 9%. Secondly, there were identified positive BIM education indications for a BIM infant country: a training centre teaching some aspects of BIM in their software courses and the interest of integrating BIM into a university curriculum.

These results suggested investigating the presence of BIM education in the country further. As stated earlier, BIM education is the solution to the lack of BIM skilled professionals in the AEC industry. Moreover, Smith (2014) points out that BIM education, training and research are

vital practices to propel the implementation and evolution of BIM in the industry. Therefore, the theme of BIM education is considered an essential aspect to be included in the toolkit, which is the projected outcome of the research.

3.2 Main study

After the preliminary study, a theoretical BIM education framework was conceived from reviewing the literature about BIM education, which is intended to be part of the toolkit of the research (Silverio *et al.* 2016). Then, the main study was carried out following the same lines of the preliminary study but with a deeper approach and a larger sampling. Besides exploring construction organisations to identify their working pattern and levels of BIM awareness and implementation, the main study considered the theme of BIM education, as suggested by the preliminary study. For that, it was undertaken an ongoing investigation to explore the presence of BIM education in the country and professionals related somehow to the delivery of BIM education in the country were contacted and interviewed.

3.2.1 Investigation of BIM education in the country and selection of participants

As previously mentioned, the first manifestations of BIM education in the country were identified in the preliminary study: The *Training Centre A* that delivers a sort of BIM seminar in the last stage of a software course and the intentions of integrating BIM in the Civil Engineering curriculum of *University B*.

Table 1 Results of the online search about BIM education.

Key words combination	Results
<i>BIM + Educacion + Republica + Dominicana</i>	BIM Diploma course and BIM informative in <i>University A</i> Conference dedicated to BIM and IPD in <i>University B</i>
<i>BIM + Diplomado + Republica + Dominicana</i>	BIM Diploma course in <i>University B</i> Three Revit courses and one ArchiCAD course
<i>BIM + Cursos + Republica + Dominicana</i>	Webpage of an Architect dedicated to the dissemination of BIM knowledge
<i>BIM + Universidad + Republica + Dominicana;</i> <i>BIM + Formacion + Republica + Dominicana</i>	No results

After the analysis of the preliminary study, an investigation about BIM education was conducted to explore more manifestations of BIM education in the country and look for potential participants that could be interviewed in the main study. The investigation consisted in an online search using combinations of key words (in Spanish) related to BIM education and training. As presented in Table 1, the results were mainly about training. There were found two Diploma courses, a conference, BIM software courses and an Architect dedicated to the dissemination of BIM knowledge. Secondly, websites of universities that offer careers related to construction were searched, and the same combinations of key words were used to search in the social networking *LinkedIn*; however, none of the searches provided new results.

Table 2 Profile of the participants of the study.

Interviewee	Profile
A	Civil Engineer and MSc in BIM.
B	Non-graduate. He was a student of Architecture.
C	Civil Engineer. Professor and Researcher at <i>University A</i> .
D	Architect. Founder member of <i>Training Centre C</i> .
E	Architect. Director of the Continuing Education Department of the Headquarters of <i>Professional Body A</i> .

F	Architect. Professor at <i>University C</i> , CEO of <i>Training Centre A</i> , and exclusive Vectorworks provider
G	Freelance Architect.
H	Civil Engineer. Professor at <i>University A</i> .
I	Architect.

From this online search, could only be contacted a representative (*Interviewee C*) from *University A* and the Architect mentioned above (*Interviewee G*). Furthermore, a representative (*Interviewee E*) of a Professional Body (*Professional Body A*) was contacted due to a BIM talk that was hosted by this institution and conducted by *Interviewee G*. The rest of participants were identified by references, through the snowball sampling strategy (Atkinson & Flint 2001). This paper presents the data analysed so far in the study. In Table 2 are describe the profile of the participants.

3.2.2 Design of the interviews

The interviews were intended to examine the involvement of the interviewees with BIM education by inquiring how they got interested in BIM, how they acquired knowledge about BIM, how they started to get involved with BIM education and the manners in which they are related to BIM education. Other topics that the interview aimed to explore were: their projects concerning BIM education; practical experience of implementing BIM; points of view of the implementation of BIM in the country; challenges they perceive; and the actions they consider necessary to propel the implementation of BIM in the country.

3.2.3 Analysis of the interviews

The interviews were conducted in Spanish, audio recorded, and subsequently transcribed and translated into English. Data were analysed with content analysis, a methodical coding and categorisation method that determines the tendency and patterns of the words, their frequency, their relationships and compositions, contexts and dialogues of communication (Grbich 2012). The analysis of the study focused on coding the data to identify themes and relationships among the interviews. The data was managed and coded with the software NVivo.

4. Findings

This study will present four key findings of BIM education in the DR: *Shortage of BIM experts*, *Lack of BIM education (Presence of training)*, *Dissemination of BIM knowledge*, and *Future strategies as to BIM education*.

4.1 Shortage of BIM experts

The shortage of BIM experts is a common challenge in the provision of BIM education. Gardner *et al.* (2014) indicate that there is a small group of educators dedicated to spreading BIM knowledge across the industry because BIM is relatively new and its implementation in the sector is still progressing. Therefore, it was not a surprise to see the same scenario in the DR. First, it was hard to identify people related to BIM education in the country. Furthermore, from the nine participants presented in this paper, three are not BIM experts and do not deliver any BIM knowledge themselves (*Interviewees C, D and E*). They are just supporters of the dissemination of BIM knowledge (Refer to Table 3).

4.2 Lack of BIM education (Presence of training)

In the same manner, the study could confirm the lack of BIM education in the country identified in the preliminary study. Thus far, BIM education is not provided in academia. There is only presence of BIM training focused on software. Training is delivered in the form of software courses and diploma courses. Companies are demanding in-house software training and consultancies to implement BIM in their practices. Moreover, BIM knowledge is currently being disseminated in the country through educational activities and BIM communities.

The lack of BIM education in the country affects not only the AEC industry but also the stakeholders involved in the delivery of BIM training/knowledge. As presented in Table 3, many of the interviewees are autodidacts in the subject of BIM. Only interviewees *A, C, H* and *I* took a BIM Diploma course in the country and, besides that, *Interviewee A* got Master's degree in BIM abroad.

4.2.1 Software courses

Software courses are the most common type of training delivered nationwide related to BIM. However, the majority do not tend to focus on BIM implementation. In their description, most of them do not even mention the word BIM and when they do is basically to point out that the software is capable of working in a BIM environment. This issue was even reported by several interviewees (*A, B, G, H and I*) who criticised training centres in the country not only for their lack of BIM focus in their software courses but also for their deficiency in teaching software.

Table 3 Academic background of the participants and BIM training/knowledge they provide.

Interviewee	Academic background on BIM	Modes of delivering BIM knowledge and training
A	- BIM Diploma course in <i>University A</i> - MSc in BIM in the UK	- Coordination of the BIM Diploma course in <i>University A</i> ; - Talks.
B	- No education. Autodidact with books and the internet.	- Talks; - Revit courses oriented to BIM; - Revit in-house training and BIM champion of the company he works for.
C	- BIM Diploma course in <i>University A</i> . Does not teach about BIM; he is just a supporter.	- Coordination of the BIM Diploma course and talks in <i>University A</i> ; - Coordination of the insertion of two BIM modules in the Civil Engineering curriculum of <i>University A</i> .
D	- No education. Just software courses in Revit. Does not teach about BIM; he is just a supporter.	- Development of conferences where BIM talks and panels have been included; - Coordination of Revit courses oriented to BIM.
E	- No education. Does not teach about BIM; he is just a supporter.	- Host talks; - Interest in delivering courses on BIM.
F	- No education. Autodidact with books and the internet.	- Talks; - Vectorworks courses oriented to BIM; - Software consultancy to companies.
G	- No education. Autodidact with the internet.	- Revit courses oriented to BIM; - BIM Diploma courses; - Revit in-house training and BIM implementation strategies consultancy to companies; - Talks.
H and I	- BIM Diploma course in <i>University A</i> .	- Coordination of the BIM Diploma course in <i>University A</i> ; - BIM Diploma courses; - Participation and organisation of talks, conferences and forums in <i>University A</i> and Training Centre D; - Training and consultancy to companies; - Revit training courses oriented to BIM.

Contrary to this trend, several of the interviewees (*B, F, G, H and I*) that provide BIM software courses reported that they teach their students about BIM through in their classes:

- Interviewee G: I explained to them BIM with Revit as follows: Revit has different wall types [...] These walls have a definition that is called LOD in BIM [...] “For you to do a LOD 100, you need a simple basic wall”, “For a LOD 400, you need a basic compound wall and is done this way. And because this wall has a LOD 400, it allows you to do construction programming and cost estimation”. So, in this way I do both, I teach Revit and BIM [...]

4.2.2 Diploma courses

BIM Diploma courses were the most formal type of training identified. These courses are not regularly provided and tend to be focused on software. When the investigation was conducted, were only found two Diploma courses that were delivered in 2013. The first BIM Diploma course registered was given in *University A*, a recognised University that offers the career of Civil Engineering. The second one was given in *University B*, another prestigious university that provides the careers of Civil Engineering, Architecture and Interior Design.

BIM Diploma course in University A. The course was organised by the staff of this university (including interviewees A, C, H and I) along with Professors from an American University, who were the facilitators. The Diploma course was conceived from an agreement between both universities. As per Interviewee C, the course mainly covered an introduction to BIM, modelling in Revit and the use of Navisworks for programming and clash detection.

BIM Diploma course in University B. Even though the facilitator of this Diploma course could not be contacted for the study, some details of the course could be extracted from the internet. Among the objectives of the Diploma course was to identify and define IPD and BIM processes, explain the use the software Revit and Navisworks and their implementation in BIM and IPD, and the development of a BIM project.

During and after the interviews were conducted, were identified other interviewees that got involved in the delivery of this type of training. When interviewed, Interviewee G stated to have designed a BIM Diploma course where was planned to teach BIM along with the software Revit. The course was projected to be delivered at the beginning of January in two universities and had a high reception. Furthermore, after the interviews, it was published a BIM Diploma course to be provided by interviewees H and I in the *Training Centre D*. The course consisted of three modules: Introduction to BIM, Project’s coordination with BIM and Implementation of BIM; and it required students to be Revit skilled to enrol.

4.2.3 In-house training and BIM consultancy to companies

Several of the interviewees have been demanded the provision of these services, which infers that construction companies are getting interested in BIM. Interviewee B is driving the implementation of BIM as the BIM champion of the in the company where he works. Interviewee E has delivered software consultancy to companies through the *Training Centre A*. Interviewee G has driven the implementation of BIM in some companies, and he states this is the activity he is demanded the most. He also provides in-house training in the software Revit, service that he has even delivered abroad. Interviewees H and I have given consultancies in BIM implementation strategies to companies and in-house training in the software Revit and Navisworks.

4.3 Dissemination of BIM knowledge in the country

As per Mordue *et al.* (2015), events and gatherings are excellent places where people can network with colleagues, unite forces and share ideas. Networking in these type of activities is very significant and allow people interested in BIM to meet frequently to talk about topics and the improvement of BIM in the industry. In the DR, were identified educational events such as talks, conferences, and forums about BIM. All the interviewees have been involved in this type of activities either as facilitators or organisers (Refer to Table 3). These activities have been mainly hosted in universities throughout the country, followed by conferences, professional bodies, and training centres. They are becoming very popular lately. After the conduction of the interviews, the ongoing investigation identified the planning and delivery of four BIM talks between March and August 2017.

Mordue *et al.* (2015) also point out that associations and forums are places where people unite their forces (either in person or virtually) to share ideas, thoughts, and point of views on

specific issues usually through sub-committees or specialist group interest fields. This mode of sharing knowledge also exists in the country. In December 2016 was created the first informative BIM forum of the country, led by five professionals of the AEC industry, including the researcher. The forum has an interactive web page where its members write BIM articles of “quick read” and share information about BIM, local and international BIM events, and places where people can seek for BIM education/training.

The interest in the delivery of BIM knowledge in the country has also come from institutions such as professional bodies. The *Professional Body A* has hosted activities where BIM knowledge have been disseminated: an introductory BIM talk conducted by Interviewee *G*; and seminars held by Interviewee *H* and *I* where the topic of BIM has been covered. Moreover, Interviewee *E* confirmed that the institution is interested in offering BIM courses. There was already one attempt of delivering a BIM Diploma course from the institution, and they currently want capable facilitators for this purpose. After the interview, they have worked along with the forum mentioned above and organised a BIM talk that had a high reception in the AEC industry.

4.4 Future strategies on BIM education

A significant finding was to identify the plan of a university to integrate BIM within a career’s curriculum. As per interviewees *A* and *C*, there was a curriculum reform in the career of Civil Engineering in *University A* which will take effect from the students enrolled since August 2016. The modifications encompass the improvement of one module and the insertion of a new module, both to be delivered in the last year of the career. The modified module is called “*Technical drawing for Civil Engineering*” and students will be taught the software Revit instead of the traditional AutoCAD. Interviewee *C* explained that the name of the new module is “*Computer Aided Design*” and Interviewee *A* has been hired already by the university to be its facilitator. The content is still under development; however, Interviewee *A* gave some details including the intentions of teaching students the software Navisworks.

It can be observed that, like the BIM training found in the country, the strategy of integrating BIM in this university is also focused on teaching specific software. Rooney (2017) identified this problem in the BIM education delivered in several countries across the world (Australia, Singapore, Sweden, the UK and the USA). Education about openBIM concepts, BIM management, and BIM collaborative environments is increasing but has a long way to go in the majority of the countries.

It is important to note that, even though the insertion of these modules directed to BIM is part of a curriculum reform that will take effect in 2019 approximately, the university is already introducing BIM to their students. Interviewee *C* explained that since 2012, in the module “*Construction Administration*” of Civil Engineering, students are given a class called “*Introduction to BIM*.”

Moreover, the current modes of BIM training and dissemination of BIM knowledge in the country are likely to increase. In response to the question about their plans concerning BIM education, the interviewees stated that they will continue with their work and want to expand it and explore further areas. Among these projects can be mentioned: creation of BIM diploma courses (Interviewees *A*, *B* and *D*); propose the delivery of BIM Diploma courses in *Professional Body A*, mainly in the countryside (Interviewees *H* and *I*); delivery of multidisciplinary software trainings (Interviewee *D*); delivery of Navisworks software courses Interviewees *A* and *D*); and host more BIM events and deliver BIM courses in the *Professional Body A* (Interviewee *E*).

Some interviewees shared other ambitious plans. Interviewee *A* wants to create BIM groups, do research about BIM and elaborate documents such as BIM standards for the country. In the same manner, Interviewee *G* intends to create a BIM standard with the group of students and colleagues he has gathered on his labour as an educator. Also, Interviewee *H* and *I* plan to propose the implementation of BIM in governmental institutions.

5. Conclusions and future work

This study explored the status of BIM education in the Dominican AEC industry. For a BIM infant country, the manifestations of the BIM education are moving in the right direction in the DR. Thus far, there is only provided BIM training which focus on teaching software, and there are different modes of dissemination of BIM knowledge. The current BIM training delivered in the country is prone to expand as BIM training providers are keen to continue with their labour

and teach in other areas. Moreover, the involvement of professional bodies and the creation of BIM communities are good indicators that the implementation of BIM and demand of BIM education are likely to increase in the country.

Furthermore, the interest in BIM is rising in academia. Many universities throughout the country are already hosting workshops/events to disseminate BIM knowledge. The most remarkable progress identified was the plan of integrating BIM into the University curriculum. The integration is designed to be in complementary modules and focused on BIM software, a problematic pattern that has been even identified in several BIM leader countries, but that is being surpassed with time. These findings suggest the need for guidance for a successful integration of BIM in academia, which is the main BIM education provider. Support from the government, the industry and academia and the creation and implementation of BIM education frameworks would be needed for these purposes. A theoretical BIM education framework has been already elaborated in the research to be part of the toolkit. Future work includes the revision of the framework with the collected data for potential improvements and the dissemination of other relevant findings.

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Proceedings of the International Conference on Sustainable Futures

This proceedings contains 68 papers submitted by researchers from 20 countries around the globe into the International Conference on Sustainable Futures (ICSF). The conference was held under the Patronage of HE Dr. Majid bin Ali Al Nuaimi, the Minister of Education in the Kingdom of Bahrain, and organised by Applied Science University in collaboration with London South Bank University (LSBU), UK. This conference, which centered on the three sustainability pillars: Technology, Environment and Economics, taking into account future studies and changes within the global context, has contributed to the implementation of the Vision 2030 of the Kingdom of Bahrain. The ICSF served as an international and inter-disciplinary platform where academics and industry had the opportunity to explore emerging trends and address obstacles affecting sustainable futures in addition to recommending potential solutions.

The Editors

Professor Ghassan Aouad is the President of Applied Science University in Bahrain and Past President of the Chartered Institute of Building. During his research career which spans over 25 years, he successfully supervised 24 PhD students, externally examined 52 PhD students, authored 3 major research books and co-authored one book, generated more than £10M in research funding as Principal Investigator and £8M as Co-Investigator, published 92 papers in top rated refereed journals, delivered more than 50 keynote speeches and invited lectures, and presented his work in more than 42 countries. In July 2016, Professor Aouad received an Honorary Doctorate of Technology from Loughborough University in the UK.

Doctor Assem Al-Hajj is the Vice President for Academic Affairs and Development at the Applied Science University in Bahrain since September 2015. He has a 25-year career spanning the UK, Africa and the MENA region. During his career he authored more than 80 publications, supervised more than 200 MSc dissertations, 12 PhD students, externally examined 6 PhD students, and presented in more than 100 conferences. Dr. Al-Hajj is a Senior Fellow of HEA, a Fellow of CIOB, and AIQS. He was selected by The FM Middle East magazine as one of the 50 most influential professionals in the Facilities Management Industry in the Middle East in 2012 to 2014 and he is the Winner of 2013 MBM Research and Teaching Award at the AIQS Australia.

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